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THE FIFTH SUMMER MEETING OF THE ASSOCIATION.

The fifth summer meeting of the Mathematical Association of America was held at the University of Chicago on Monday, September 6, 1920, in conjunction with, and immediately preceding, the summer meeting and colloquium of the American Mathematical Society. 132 were present at the meeting, including the following 114 members of the Association:

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| O. W. ALBERT, Grinnell College. | M. G. GABA, University of Nebraska. |
| EDNA ALLEN, Chicago, Ill. | C. D. GARLOUGH, Wheaton College. |
| R. C. ARCHIBALD, Brown University. | W. H. GARRETT, Baker University. |
| G. N. ARMSTRONG, Ohio Wesleyan University. | D. C. GILLESPIE, Cornell University. |
| | R. E. GILMAN, Brown University. |
| P. M. BATCHELDER, University of Texas. | CORNELIUS GOUWENS, State College of Iowa. |
| I. A. BARNETT, University of Saskatchewan. | C. F. GUMMER, Queen's University. |
| SUZAN R. BENEDICT, Smith College. | |
| A. A. BENNETT, University of Texas. | W. L. HART, University of Minnesota. |
| G. D. BIRKHOFF, Harvard University. | M. W. HASKELL, University of California. |
| VEVIA BLAIR, Horace Mann High School. | OLIVE C. HAZLETT, Mount Holyoke College. |
| G. A. BLISS, University of Chicago. | E. R. HEDRICK, University of Missouri. |
| R. L. BORGER, Ohio University. | ALBERT HEINZ, Tsing Hua College. |
| J. W. BRADSHAW, University of Michigan. | T. H. HILDEBRANDT, University of Michigan. |
| W. H. BUSSEY, University of Minnesota. | L. A. HOPKINS, University of Michigan. |
| | JEWELL C. HUGHES, University of Arkansas. |
| W. D. CAIRNS, Oberlin College. | W. A. HURWITZ, Cornell University. |
| D. F. CAMPBELL, Armour Institute of Technology. | |
| J. W. CAMPBELL, University of Alberta. | DUNHAM JACKSON, University of Minnesota. |
| A. L. CANDY, University of Nebraska. | G. H. JAMISON, Kirksville (Mo.) State Normal School. |
| J. A. CAPARO, Notre Dame University. | |
| F. E. CARR, Oberlin College. | CLARIBEL KENDALL, University of Colorado. |
| W. E. CEDERBERG, University of Wisconsin. | S. D. KILLAM, University of Alberta. |
| E. W. CHITTENDEN, University of Iowa. | J. M. KINNEY, Hyde Park (Chicago) High School. |
| L. M. COFFIN, Coe College. | H. W. KUHN, Ohio State University. |
| A. R. CRATHORNE, University of Illinois. | |
| D. R. CURTISS, Northwestern University. | GILLIE A. LAREW, Randolph-Macon Woman's College. |
| | D. A. LEHMAN, Goshen College. |
| H. H. DALAKER, University of Minnesota. | FLORA E. LE STOURGEON, University of Kentucky. |
| Sister MARIOLA DOBBIN, St. Clara College. | MAYME I. LOGSDON, University of Chicago. |
| E. L. DODD, University of Texas. | A. C. LUNN, University of Chicago. |
| J. E. DOTTERER, Manchester College. | E. B. LYTLE, University of Illinois. |
| L. W. DOWLING, University of Wisconsin. | |
| OTTO DUNKEL, Washington University. | S. H. MACDONALD, Colorado Agricultural College. |
| M. D. EARLE, Furman University. | L. E. MCCARTY, Michigan College of Mines. |
| G. C. EVANS, Rice Institute. | R. B. MCCLENON, Grinnell College. |
| H. S. EVERETT, Bucknell University. | J. V. MCKELVEY, Iowa State College. |
| | HELEN A. MERRILL, Wellesley College. |
| ZOE FERGUSON, Crane Junior College. | BESSIE I. MILLER, Rockford College. |
| B. F. FINKEL, Drury College. | |
| L. R. FORD, Rice Institute. | |
| W. B. FORD, University of Michigan. | |

W. L. MISER, Armour Institute.
 C. N. MOORE, University of Cincinnati.
 E. H. MOORE, University of Chicago.
 E. J. MOULTON, Northwestern University.
 F. R. MOULTON, University of Chicago.

A. L. NELSON, University of Michigan.

H. L. OLSON, University of Michigan.

ANNA H. PALMIÉ, Western Reserve University.
 ANNA J. PELL, Bryn Mawr College.
 T. A. PIERCE, University of Nebraska.
 A. D. PITCHER, Western Reserve University.

S. E. RASOR, Ohio State University.
 R. G. D. RICHARDSON, Brown University.
 H. L. RIETZ, University of Iowa.
 W. J. RISLEY, James Millikin University.
 MARIA M. ROBERTS, Iowa State College.
 PERCIVAL ROBERTSON, The Principia, St. Louis.
 W. H. ROEVER, Washington University.

MINNA J. SCHICK, University of Minnesota.
 OSCAR SCHMIEDEL, Nebraska Wesleyan University.

IDA M. SCHOTTENFELS, Chicago, Ill.
 E. W. SHELDON, University of Alberta.
 H. A. SIMMONS, University of Michigan.

W. G. SIMON, Western Reserve University.
 E. B. SKINNER, University of Wisconsin.
 H. E. SLAUGHT, University of Chicago.
 E. B. STOUTER, University of Kansas.
 C. E. STROMQUIST, University of Wyoming.
 K. D. SWARTZEL, Ohio State University.

E. J. TOWNSEND, University of Illinois.

A. L. UNDERHILL, University of Minnesota.
 P. H. UNDERWOOD, Ball High School, Galveston.

OSWALD VEBLEN, Princeton University.

J. H. WEAVER, Ohio State University.
 W. P. WEBBER, University of Pittsburgh.
 F. M. WEIDA, University of Iowa.
 MARY E. WELLS, Vassar University.
 W. D. A. WESTFALL, University of Missouri.
 MARION B. WHITE, Carleton College.
 C. E. WILDER, Northwestern University.
 F. B. WILEY, Denison University.
 VERA L. WRIGHT, University of Minnesota.

C. H. YEATON, School of Engineering of Milwaukee.

J. W. YOUNG, Dartmouth College.
 J. W. A. YOUNG, University of Chicago.

It is noteworthy that there were in attendance at the meeting from more distant parts of the country nine from Texas, six from Massachusetts, three each from Alberta, New York and Rhode Island, two each from Colorado, Pennsylvania and South Carolina, and one each from China, Ontario, California, Maryland, New Hampshire, New Jersey, Virginia and Wyoming.

Pleasant arrangements were made for those attending the meetings. Comfortable rooms were furnished in Beecher and Hitchcock Halls, while all had meals as well as social opportunities at the Quadrangle Club. The courtesies shown to the members were recognized in a resolution of thanks offered by Professor Veblen. The joint banquet of the two organizations was held on Tuesday evening where about 110 members and friends were present. At this joint dinner brief speeches were made by the toastmaster, Professor Slaughter, and by Professor Birkhoff as representing the Society, Professor Merrill as representing the Association, Professors Veblen, Killam, Hedrick and Hurwitz. On Thursday evening the members of the two bodies and their friends were delightfully entertained at a reception at the home of Professor and Miss Slaughter. Professor Lunn contributed greatly to the enjoyment by his piano solos.

Vice-President MERRILL presided at the morning session and Professor VEBLEN at the afternoon session. The following papers were read:

(1) "On certain fundamental principles in the mathematics of life insurance" by Professor D. F. CAMPBELL, Armour Institute of Technology.

(2) "Certain features of the application of Makeham's laws of mortality" by Professor H. L. RIETZ, University of Iowa.

(3) "The plan of pensions and insurance recommended by the Carnegie Foundation for the Advancement of Teaching" by Professor E. L. DODD, University of Texas.

(4) Report of progress of the National Committee on Mathematical Requirements, by Professor J. W. YOUNG, Dartmouth College.

(5) "The debt of mathematics to the experimental sciences" by Professor A. C. LUNN, University of Chicago.

(6) Discussion of Professor Lunn's paper with respect to its bearing upon research in pure mathematics, by Professor E. H. MOORE, University of Chicago.

(7) Discussion of Professor Lunn's paper with respect to its bearing on mathematical curricula, by Professor M. W. HASKELL, University of California.

(8) "Retrospect and prospect for mathematics in America,"—retiring presidential address by Professor H. E. SLAUGHT, University of Chicago.

Abstracts of the papers and discussions follow below, the numbers corresponding to the numbers in the list of titles:

1. Professor Campbell's paper dealt with some of the theorems of mathematics underlying the principles of life insurance. He explained various of the principles of interest touching upon nominal and effective interest, force of interest, and present values. Then he took up some problems in probability in connection with the mortality table and derived a few formulas in annuities and insurance, pointing out the special technique of avoiding extensive calculations. He finally treated the subject of reserves and a method of calculating these.

2. In the introduction to this paper, Professor Rietz outlined briefly the historical development of the ideas in Makeham's functions expressive of human mortality. He then gave an exposition of the properties of these functions that make them of fundamental importance in the problems of joint life and survivorship insurance and annuities. It was shown in this paper not only how a Makehamized table following Makeham's first modification of the Law of Gompertz leads to economy of time and energy, but it is shown also how a mortality table following the second modification of the Law of Gompertz may be applied to advantage in the problems of joint life and survivorship insurances and annuities.

3. The Carnegie Foundation recommends, as especially suited to the needs of college teachers, a combination of insurance, non-convertible term insurance or decreasing whole-life insurance, with a savings account—interest at 4 per cent. or $4\frac{1}{2}$ per cent.—to purchase a pension upon retirement or to pass to the estate upon death. These forms of protection—as, indeed, also the more common forms of insurance—can be purchased by teachers from The Teachers Insurance and

Annuity Association at cost. No part of a teacher's payment is used for the expenses of the company.

The more common forms of insurance are (1) non-convertible term, (2) term, convertible to other forms, (3) whole life, (4) limited payment life, and (5) endowment. With the exception of (1), these forms all involve an endowment or cash value, which can be used to purchase a pension. Indeed, with the exception of (1), the forms are all good; and they are well adapted to the needs of a man on moderate income who has some ability to save. For men on very small income, forms (2) and (3) are to be preferred; for men who find it difficult to save, form (5) or the plans suggested by The Carnegie Foundation. The more common forms of insurance are more flexible; but the Foundation plans bind the accumulations strictly for pension purposes. As pension plans, however, they exhibit very considerable flexibility, because of the various options permitted.

4. The report of Professor Young is embodied in the reports printed in the July-September issue of the MONTHLY and elsewhere (pages 441-442) in the present issue.

5. An important portion of the concepts of present mathematical science has emerged by abstraction and generalization from notions originally quite special and concrete occurring in experimental sciences. The successive steps in development have often been carried quite far under the impulse of suggestion from the experimental relations.

Professor Lunn's paper was devoted primarily to a commentary of illustration from the theories of mechanics, heat and electromagnetism. Historical sketches were given of examples leading to familiar general notions in the theories of quadratic forms, modern geometry, differential and integral equations. It is to be hoped that this paper may be available to those not present at the meetings.

6. Professor Moore in his discussion discriminated between the different aspects of research. (1) The process. In research in applied mathematics this does not differ essentially from that in pure mathematics, except that the latter does not need the elaborate equipment necessary in the former. The main speaker, it was pointed out, had brought out the fact that he who comes to pure research with a large background of experimental knowledge has a great aid in his work. Professor Moore instanced by reference to his own study of matrices the possibility of the discovery through generalization of *tools* of great usefulness. (2) Ideals of research, (a) of the individual, (b) of the group of individuals. Here distinct advantages come directly from the "right" of the experimental sciences to the "left" of the abstract fields; the "foundations" may well serve to make a contribution in the reverse direction. We have much in evidence at the present time in the way of scholarship and of research ability. We must develop the ideal of the group, as is beginning to be done in this country. (3) The form. One should choose the form in which he casts his research such that it shall be most clearly understood by those not conversant with his subject.

There must be a differentiation between various parts of research, yet if science is to advance, there must be a compensatory unifying principle. While mathematical principles have emerged, sometimes directly and logically, sometimes by way of analogy, from the various sciences as described by Dr. Lunn, in the higher reaches of pure mathematics there should be a working out of the principles embodied in physical research in a form free from mere analogy.

7. The mathematical curriculum has changed greatly in recent years. We cannot legitimately include a subject in the curriculum unless we can justify its inclusion to those taking the course. Professor Haskell regarded Professor Lunn's paper as a strong plea for the introduction of the element of interest in mathematics; we must be able to give the student reasons for studying it and must first of all know the reasons ourselves. We must furthermore give the students something in mathematics which shall relate itself to their own lives. We should, for example, show them the advantage of a mathematical formulation; trigonometry has here its great appeal. With less ease, yet in a feasible way, we may make college algebra an attractive subject instead of a bugbear.

Professor Jackson spoke of the lamentable lack of agreement existing between mathematicians and physicists. A single example, he said, would serve, viz., it would aid greatly if we would present existence theorems not so much as proofs of the existence of solutions (which usually are found by entirely different methods) as means of finding solutions where other methods fail.

8. The inspiring retiring address of President Slaught will appear in the December issue of this MONTHLY.

MEETING OF THE COUNCIL OF THE ASSOCIATION.

Eleven members of the Council were present at the meeting.

The following seventy persons and three institutions, on applications duly certified, were elected to membership (making 181 new memberships since January 1, 1920):

NINA M. ALDERTON, A.M. (Columbia). Asst. and grad. student, Univ. of California, Berkeley, Calif.

H. E. ANDERSON, A.M. (Augustana Coll.). Muhlenberg Coll., Allentown, Pa.

W. A. AUSTIN, A.M. (Indiana). Head of dept. of math., High School and Junior Coll., Fresno, Calif.

KATE C. BARBOUR, A.B. (Oklahoma). Teacher, High School, Norman, Okla.

J. F. BARNHILL, A.B. (Kansas). Supt., City Schools, Parsons, Kans.

P. M. BATCHELDER, Ph.D. (Harvard). Instr. in pure math., Univ. of Texas, Austin, Tex.

W. D. BATEN, A.M. (Texas). Head of dept. of math., Grubbs Vocat. Coll., Arlington, Tex.

SÉVÉRIN BAYS, Ph.D. Professeur agrégé, Univ. of Fribourg, Switzerland.

FLORENCE A. BIXBY, A.M. (Columbia). Head of dept. of math., Riverside High School, Milwaukee, Wis.

- ETTORE BORTOLOTTI, Dottore in Mat. Prof. ord. di analisi algebrica, Univ. of Bologna, Italy.
- M. LUCILE BROWN, A.M. (Ohio State). Instr., Western Coll., Oxford, Ohio.
- GLADYS-MARY E. CAMPBELL, A.B. (California). Asst., Univ. of California, Berkeley, Calif.
- MICHELE CIPOLLA, Dottore in Mat. (Palermo). Prof. ord. di analisi algebrica, Univ. of Catania, Italy.
- R. F. CLARK, A.B. (Williams), Pd.B. (Albany State Normal). Chairman of dept. of math., De Witt Clinton High School, New York, N. Y.
- L. H. CUTTING, B.S. (Chicago) Teacher, Westport High School, Kansas City, Mo.
- J. A. ELY, C.E. (Princeton). Prof., St. John's Univ., Shanghai, China.
- STEPHEN EMERY, A.M. (Boston). Head of dept. of math., Erasmus Hall High School, Brooklyn, N. Y.
- P. H. EVANS. Chief actuary, Northwestern Mut. Life Ins. Co., Milwaukee, Wis.
- H. L. FASSETT, A.M. (Bucknell). Head of dept. of math., South Side High School, Newark, N. J.
- D. D. FELDMAN, B.S. (Nebraska). Prin., Curtis High School, Staten Island, N. Y.
- L. R. FORD, Ph.D. (Harvard). Asst. prof., Rice Inst., Houston, Tex.
- Z. G. DE GALDEANO, Dr. in Ciencias matemáticas. Prof., Univ. of Zaragoza, Spain.
- FALKA M. D. GIBSON, A.B. (California). Teacher, High School, Orland, Calif.
- MARIA D. GRAHAM, B.S. (Teachers Coll.). Head of dept. of math., Teachers Training School, Greenville, N. C.
- MAY V. HAWORTH, Ph.B. (California). Vice-prin., High School, Alameda, Calif.
- W. S. HIGGINS, M.E.E. (Harvard). Prof. of math. and engg., Southwestern Presbyt. Univ., Clarksville, Tenn.
- L. A. HOPKINS, Ph.D. (Chicago). Asst. prof., Univ. of Michigan, Ann Arbor, Mich.
- M. H. INGRAHAM, A.B. (Cornell). Instr., Univ. of Wisconsin, Madison, Wis.
- GEORGE JACKSON, B.S. (Cincinnati). Asst. headmaster, Asheville School, Asheville, N. C.
- C. L. JOHNSON, B.S. (Ore. Agric. Coll.). Head of dept. of math., Ore. Agric. Coll., Corvallis, Ore.
- S. D. KILLAM, Ph.D. (Göttingen). Asso. prof., Univ. of Alberta, Edmonton South, Alb., Canada.
- A. V. LEBEUF. Prof. of astr. and dir. of the observatory, Univ. of Besançon, France.
- E. J. LEWIS, A.B. (Olivet). Head of dept. of math., Tech. High School, Scranton, Pa.
- L. P. LOOMIS, B.S. (Miss. College). Clinton, Miss.
- JANE H. MATHEWS, B.S. (Columbia). Teacher, Peabody High School, Pittsburgh, Pa.

- L. E. McCARTY, A.M. (Texas). Asst. prof., math. and physics, Michigan College of Mines, Houghton, Mich.
- DORA McFARLAND, A.B. (Monmouth). Instr., Univ. of Oklahoma, Norman, Okla.
- ELSIE J. McFARLAND, Ph.D. (California). Berkeley, Calif.
- EMMA L. NOONAN, A.M. (Columbia). Teacher, Girls High School, San Francisco, Calif.
- J. W. PANCOAST, B.S. (Swarthmore). Prof., Guilford College, N. C.
- HONOR K. PETTIT, A.B. (Park Coll.). Grad. student, Univ. of California, Berkeley, Calif.
- T. A. PIERCE, Ph.D. (California). Asst. prof., Univ. of Nebraska, Lincoln, Neb.
- J. F. POBANZ, A.B. (Michigan). Asst., Univ. of California, Berkeley, Calif.
- INEZ D. POWELSON, A.M. (California). Teacher, Bakersfield, Calif.
- V. V. RAMANA-SASTRIN, Ph.D. Vedaraniam, Tanjore Dt., South India.
- O. H. RECHARD, Jr., A.M. (Penna. Coll.). Instr., Univ. of Wisconsin, Madison, Wis.
- CLAIR REID, A.B. (Earlham). Instr., Purdue Univ., LaFayette, Ind.
- THERESA M. RENNER, B.S. (Blackburn). Instr., Blackburn Coll., Carlinville, Ill.
- C. P. ROCKWELL. Asst. actuary, Texas Dept. of Ins. and Banking, Austin, Tex.
- SARAH A. RUBY, A.B. (Iowa). Head of dept. of math., Jefferson High School, Portland, Ore.
- G. O. SAGEN, A.B. (California). Asst., Univ. of California, Berkeley, Calif.
- MEYER SALKOVER, A.M. (Cincinnati). Instr., Univ. of Cincinnati, Cincinnati, Ohio.
- MINNA J. SCHICK, A.M. (Northwestern). Instr., Univ. of Minnesota, Minneapolis, Minn.
- L. SILBERSTEIN, Ph.D. Research laboratory, Eastman Kodak Co., Rochester, N. Y.
- E. B. SKINNER, Ph.D. (Chicago). Prof., Univ. of Wisconsin, Madison, Wis.
- I. W. SMITH, A.M. (Illinois). Prof., North Dakota Agric. Coll., Fargo, N. D.
- W. A. STAFFORD, A.M. (Stanford). Head of dept. of math., High School, Oakland, Calif.
- G. C. STALEY, A.M. (Chicago). Instr., Parker High School, Chicago, Ill.
- STELLA STEPHENS, A.B. (Georgetown Coll.). Teacher, High School, Paris, Ky.
- HELEN THOMPSON, A.B. (Vassar). Head of dept. of math., Kentucky Coll. for Women, Danville, Ky.
- LUIS OCTAVIO DE TOLEDO. Prof., Univ. of Madrid, Spain.
- R. S. UNDERWOOD, A.M. (Minnesota). Instr., Purdue Univ., LaFayette, Ind.
- LOUIS VAN HEE. Jesuit Father; Prof of math., Liège, Belgium.
- P. W. WATERMAN, Ph.B. (Vermont). Head of dept. of math., Montclair Acad., Montclair, N. J.
- J. H. M. WEDDERBURN, D.Sc. (Edinburgh). Asst. prof., Princeton Univ., Princeton, N. J.
- HELEN F. WEEKS, B.S. (California). Head of dept. of sc. and math., High School, Alhambra, Calif.

B. C. WONG, A.M. (California). Asst., Univ. of California, Berkeley, Calif.

RUTH G. WOOD, Ph.D. (Yale). Prof., Smith Coll., Northampton, Mass.

JESSICA M. YOUNG, M.S. (California). Instr., math. and astr., Washington Univ., St. Louis, Mo.

VIVIAN YOUNG, A.B. (Willamette). Head of dept. of math., High School, Salem, Ore.

To institutional membership.

ST. MARY-OF-THE-WOODS COLLEGE, St. Mary-of-the-Woods, Ind.

NORTHERN NORMAL AND INDUSTRIAL SCHOOL, Aberdeen, S. Dak.

UNIVERSITY OF WYOMING, Laramie, Wyo.

A report was made for the committee on life membership. It was agreed that more study should be devoted to this subject and a committee of three actuarial members of the Association was appointed which should report on the actuarial features of the proposed life membership fee, including the feasibility of a fee graduated according to age.

It was voted to accept the invitation of Wellesley College for the summer meeting in 1921.

It was voted to accept the invitation of the staff of the University of Chicago for the next annual meeting in affiliation with the meeting of the American Association for the Advancement of Science; and through a later report of the committees of the Association and the Society it was agreed that there should be morning and afternoon sessions of the Association on Tuesday, December 28, simultaneous sessions of the two bodies on Wednesday morning, a joint session of these with Section A of the American Association on Wednesday afternoon, and further sessions of the Society on Thursday.

The most important action of the Council was in regard to the financial situation of the Association. Like other scientific periodicals, the cost of publication of the MONTHLY has increased about 50 per cent. during the past year; and provision needs now to be made for editorial and clerical assistance in the office of the editor-in-chief. Because of these additions, it appears, according to a report made to the Council by the Secretary-Treasurer, that the reserve in the Association treasury will be more than wiped out in the next year if no additional income is secured. The Council after careful and full consideration, both by correspondence during the past summer and by conference at the Chicago meeting, believes that the members are so strongly committed to the ideals and accomplishments of the Association and of its worth to themselves, that they will loyally approve increased membership dues as one means of offsetting the increased expenses. The Council therefore voted to increase the individual dues to four dollars, the institutional dues to seven dollars, and subscriptions for non-members to five dollars, beginning with January, 1921. An exception was made to this in the case of those who at that time will have been members for less than one year; it seems only fair to exempt these from the increase until January, 1922, thus giving them a full year on the basis of the dues prevailing when they joined.

Since twice as much additional revenue must be secured as will come from the increase in membership dues, if the income of the Association is to equal its expenditures, a committee of the Council has been appointed to invite subscriptions, aside from membership dues, which may be applied to the current budget or to permanent endowment. A third method by which members can readily come to the financial aid of the Association is for each member to invite and urge others to become members; if we believe in the value of the Association's work, we can rightfully bring this to the attention of all the members of the staff and to advanced students of mathematics at each college and university, and to other persons definitely interested in mathematics.

To the end that our organization may legally receive donations and bequests, the Council took steps to incorporate the Association. Both the Council and the Association unanimously adopted resolutions empowering Professors E. H. Moore, H. E. Slaught and W. D. Cairns to apply for a charter, and this action was taken by them at once. Since then the charter has been granted and the Mathematical Association of America Incorporated has been organized under the statutes of the State of Illinois. The articles of incorporation vest the legal control in the first instance in three trustees, Professors H. E. Slaught, E. R. Hedrick and W. D. Cairns, but they have exercised their legal prerogative by enlarging the Board of Trustees to nineteen, thus including the present officers and all members of the present Council and by adopting a set of by-laws which include the by-laws and constitution of the original Association together with such modifications and additions as were necessary to meet the legal requirements. The charter of the Mathematical Association of America Incorporated now supersedes the old constitution. The property and assets of the old Association have been transferred to the newly incorporated body in accordance with the authority granted by vote of the Council. The By-Laws of the Mathematical Association of America Incorporated follow, preceded by the official minutes of the organization meeting and the Certificate of Incorporation.

W. D. CAIRNS, *Secretary-Treasurer*.

CERTIFICATE NO. 3651.

STATE OF ILLINOIS, OFFICE OF SECRETARY OF STATE.

To all to whom these Presents shall come, Greeting:

Whereas a certificate, duly signed and acknowledged has been filed in the office of the Secretary of state, on the 8th day of September, A.D. 1920, for the organization of

THE MATHEMATICAL ASSOCIATION OF AMERICA
(INCORPORATED)

under and in accordance with the provisions of "An Act Concerning Corporations" approved April 18, 1872, and in force July 1, 1872 and all acts amendatory thereof, a copy of which certificate is hereto attached;

Now, therefore, I, Louis L. Emmerson, Secretary of State of the State of Illinois, by virtue of the powers and duties vested in me by law, do hereby certify that the said

THE MATHEMATICAL ASSOCIATION OF AMERICA
(INCORPORATED)

is a legally organized corporation under the laws of this State.

IN TESTIMONY WHEREOF I hereunto set my hand and cause to be affixed the Great Seal of the State of Illinois done at City of Springfield, this 8th day of September A.D. 1920 and of the Independence of the United States the one hundred and forty-fifth.

LOUIS L. EMMERSON,
Secretary of State.

[GREAT SEAL
OF THE STATE OF
ILLINOIS]

[Filed for Record September 10, 1920 in the office of the Recorder of Cook County, Illinois as Document No. 6935590.]

MINUTES OF THE ORGANIZATION MEETING OF THE TRUSTEES OF THE MATHEMATICAL ASSOCIATION OF AMERICA (INCORPORATED), HELD AT CHICAGO, ILLINOIS, ON THE 10TH DAY OF SEPTEMBER, A. D. 1920.

There were present Messrs. Slaught, Hedrick and Cairns, being all of the Trustees acting by virtue of Application for Charter filed with the Secretary of State at Springfield, Illinois.

The meeting was called to order by Mr. Slaught, who presided. Mr. Cairns acted as Secretary of the meeting and recorded the proceedings.

Mr. Slaught reported that Application for Charter had been duly filed with the Secretary of State, that Certificate of Organization had thereon been issued by the Secretary of State and that such Certificate had been filed with, and on this 10th day of September, A. D. 1920, recorded in the office of, the Recorder of Deeds of Cook County, all in accordance with the laws of the State of Illinois; that the Association had, under the law, been fully organized and might now proceed to business.

The Chairman announced that at a meeting of the members of The Mathematical Association of America, the unincorporated organization to which it is proposed to make this Association successor, held at Chicago, Illinois, September 6, 1920, a resolution had been adopted, authorizing the Officers and the members of the Council of that organization to do all acts and things necessary to be done to complete the organization of this Association, to transfer to it the property and business of the unincorporated organization, subject to its liabilities, and, so far as possible, to provide for the continuation of the Association's business and affairs substantially along the lines prevailing in the unincorporated organization.

The Chairman announced that the first order of business was the election of a President and Secretary of the newly incorporated Association.

Thereupon, on motion duly made, seconded and unanimously carried, it was resolved that until, and subject to, the legal effectuation of the amendment to the Articles of Association for the increase of Trustees, as contemplated and hereinafter set forth, HERBERT E. SLAUGHT and WILLIAM D. CAIRNS be, and hereby are, elected, respectively, President and Secretary of this Association.

The Chairman announced that the next order of business was the adoption of By-Laws for the government of the Association and thereupon submitted a code of By-Laws which was carefully considered and, upon motion duly made, seconded and unanimously carried, adopted as the By-Laws of this Association. A copy of the By-Laws so submitted and adopted was ordered certified by the Chairman of the meeting and included in the records of this meeting.

Thereupon, on motion duly made, seconded and unanimously carried, it was resolved that Section 3 of the Articles of Association of THE MATHEMATICAL ASSOCIATION OF AMERICA (INCORPORATED) be, and hereby is, changed and amended to read as follows: "The management of the aforesaid Association shall be vested in a Board of Nineteen (19) Trustees."

Thereupon, on motion duly made, seconded and unanimously carried, it was resolved that the Officers of this Association be, and hereby are, authorized and directed to do all acts and things necessary, proper or convenient to be done in and about making legally effectual the amendment of the Articles of Association aforesaid and the consummation of the transfer to this Association of the assets, property, business and membership of the present unincorporated Association bearing the same name, including payment of all fees and expenses incident thereto out of the funds of the Association.

No further business being presented, the meeting was, on motion, duly adjourned.

WILLIAM D. CAIRNS,
Secretary of the Meeting.

Approved:

HERBERT E. SLAUGHT,
Chairman of the Meeting.

BY-LAWS OF THE MATHEMATICAL ASSOCIATION OF AMERICA (INCORPORATED).

ARTICLE I—NAME, PURPOSE AND CORPORATE SEAL.

1. This organization shall be known as

THE MATHEMATICAL ASSOCIATION OF AMERICA (INCORPORATED).

2. Its object shall be to assist in promoting the interests of mathematics in America, especially in the collegiate field, by holding meetings in any part of the United States or Canada for the presentation and discussion of mathematical papers, by the publication of mathematical papers, journals, books, monographs and reports, by conducting investigations for the purpose of improving the teaching of mathematics, by accumulating a mathematical library and by cooperating with other organizations whenever this may be desirable for attaining these or other similar objects.

3. The Corporate Seal of the Association shall have inscribed thereon the name of the Association and the words "Corporate Seal—Illinois."

ARTICLE II—MEMBERSHIP.

1. Any person who is interested in the field of collegiate mathematics shall be eligible for election to membership in the Association.

2. Any institution in which the Calculus is regularly taught shall be eligible for election to institutional membership in the Association. Such an institution shall have the privilege of sending a voting delegate to the meetings of the Association.

3. Election to membership shall be by vote of the Board upon written application from the individual or institution seeking admission.

4. Those who were admitted to membership in The Mathematical Association of America (unincorporated) prior to October 1, 1920, and are in good standing as such are hereby admitted to membership in this Association.

ARTICLE III—BOARD OF TRUSTEES AND OFFICERS.

1. The control and management of the affairs and funds of the Association shall be vested in a Board of Trustees, who shall be members of the Association. The Board of Trustees, in the first instance, shall consist of the three (3) persons named in the Certificate of Organization. It is contemplated that such Board of Trustees shall, immediately after completing the organization of the Association, amend the Articles of Association, in the manner hereinafter prescribed, to provide for a Board of Trustees numbering Nineteen (19). Such Board of Nineteen (19) shall consist of a President, two (2) Vice-Presidents, a Secretary-Treasurer, three (3) members of the Committee on Publications and twelve (12) additional members.

2. For the terms set against their respective names, the following shall, upon amendment of the Articles of Association above mentioned, be the Officers and Trustees of the Association:

Office.	Name.	Term ending with the Annual Meeting in
President.....	D. E. SMITH	December, 1920 or January, 1921.
Vice-President.....	HELEN A. MERRILL	December, 1920 or January, 1921.
Vice-President.....	E. J. WILCZYNSKI	December, 1920 or January, 1921.
Secretary-Treasurer.....	W. D. CAIRNS	December, 1920 or January, 1921.
Committee on Publication	{ W. A. HURWITZ,	December, 1920 or January, 1921.
	{ H. E. SLAUGHT, <i>Manager</i> ,	
	{ R. C. ARCHIBALD, <i>Editor in Chief</i>	
Trustees.....	{ FLORIAN CAJORI	December, 1920 or January, 1921.
	{ ELIZABETH B. COWLEY	
	{ E. L. DODD	
	{ G. A. MILLER	
Trustees.....	{ L. P. EISENHART	December, 1921 or January, 1922.
	{ B. F. FINKEL	
	{ E. V. HUNTINGTON	
	{ E. H. MOORE	
Trustees.....	{ R. D. CARMICHAEL	December, 1922 or January, 1923.
	{ E. R. HEDRICK	
	{ OSWALD VELEN	
	{ J. W. YOUNG	

3. The President and Vice-Presidents shall be elected by the Association's members annually for a term of one year, and four members of the Board shall be elected by the Association's members annually for a term of three years. They shall be eligible for reelection, but not for more than two (2) consecutive terms. The Secretary-Treasurer, and the Committee on Publications, consisting of the Manager, the Editor and one other member, shall be appointed by the Board. All Trustees and Officers shall hold over until their respective successors are elected and qualify.

4. The Board shall transact the official business of the Association and shall report its actions at the annual meeting of the Association and in the official journal. Any proposed action of the Board which makes or alters a question of policy shall be published in the official journal before final action has been taken, so that members of the Association may make known to the Board their individual views.

5. The Board shall have authority to fill vacancies *ad interim* in any office, including vacancies in the Board and in the Committee on Publications.

6. At all meetings of the Board of Trustees a quorum shall consist of not less than five (5) members and no business may be validly transacted at a meeting at which less than a quorum is present; *provided* that any meeting of the Board, whether or not a quorum be present, may be adjourned to a specified time and place by a majority of the members present without notice to the members at large other than announcement at such meeting. Informal action based on correspondence among the members of the Board, if ratified at a properly convened meeting of the Board, shall be as valid and effective as if originally authorized at such meeting.

7. Two months before the date of the annual meeting all members shall be given an opportunity to nominate by mail a candidate for each office to be elected by the members for the ensuing year. One month before the annual meeting the Board shall announce two candidates for each office to be filled by the members, one being the person who received the highest vote in the nominations and the other being selected by the Board from among the several nominees next in order. The election shall be by mail or in person and shall close on the day of the annual meeting.

8. The President shall be the executive Officer of the Association, shall preside at all meetings of the Board of Trustees and at the annual meeting of the Association. He shall have the usual duties pertaining to his office and such other duties as may from time to time be devolved upon him by the Board of Trustees.

9. The Vice-Presidents shall, in the absence of the President, have and exercise the powers of the President, their order being determined alphabetically. The Board of Trustees may devolve upon the Vice-Presidents such duties as may from time to time be determined.

10. The Secretary-Treasurer shall have the usual duties pertaining to the office of Secretary and of Treasurer, including the custody of the records of the Association and of its Corporate Seal, the keeping of minutes of the meetings of the Board of Trustees and of the annual meeting and special meetings of members, the giving of due notice of all regular and special meetings of the Association and of the Board of Trustees and the supervision and safe-keeping of the funds

of the Association. The Secretary-Treasurer shall also have the duty of seeing that whenever Trustees are elected, including the election of Trustees to fill vacancies, a Certificate, under the Seal of the Association, giving the names of those elected and the term of their office, shall be recorded in the office of the Recorder of Deeds for Cook County, Illinois. Such Certificate shall be signed by the Secretary-Treasurer and verified by oath of the President.

11. The Committee on Publications shall have supervision, subject to the control of the Board of Trustees, of the official journal and of all other publications of the Association.

ARTICLE IV—MEETINGS.

1. A meeting of the Association shall be held annually, at such time and place as the Board may direct. Special meetings of the Association may be called from time to time by the Board of Trustees, or while the Board is not in session by the President of the Association, to be held at such time and place as may appear from the call. The first annual meeting of the Association shall be held in December, 1920 or January, 1921.

2. The outgoing Board of Trustees shall hold a meeting immediately preceding the annual meeting of the Association next succeeding their election, and the members of the new Board of Trustees shall hold a meeting and organize, by completing the Board, immediately succeeding the annual meeting of the Association at which the new members thereof were elected. Further meetings of the Board may be held from time to time at the call of the President or any three (3) members of the Board.

3. Notice of any meeting of members of the Association shall be given by the Secretary-Treasurer at least thirty (30) days prior to the date set for such meeting. Notice of all meetings of the Board of Trustees other than the regular meetings provided in Section 2 shall be given to each member of the Board at least fifteen (15) days prior to the date set therefor.

4. Any member of the Association or of the Board of Trustees may waive notice with the same effect as if due notice had been given him.

5. At all meetings of the Association a quorum shall consist of not less than twenty-five (25) members and no business may be validly transacted at a meeting at which less than a quorum is present; *provided* that any meeting of the Association, whether or not a quorum be present, may be adjourned to a specified time and place by a majority of the members present without notice to the members at large other than announcement at such meeting.

6. Members may take part and vote in person or by proxy at all meetings of the Association.

ARTICLE V—SECTIONS.

1. Any group of members of this Association may petition the Board for authority to organize a Section of the Association for the purpose of holding local meetings. The Board shall have power to specify the conditions under which such authority shall be granted.

2. The Association shall not be obligated to pay from its treasury any of the expenses of such Sections.

ARTICLE VI—OFFICIAL ORGAN.

1. The Association shall publish an official journal, which shall be sent free to all members of the Association in accordance with Article VII.

2. The Board shall have full control of the publication and sale of the official journal.

3. The official journal shall be under the general management of the Committee on Publications. There shall also be appointed by the Board a body of Associate Editors who shall give assistance in connection with the official journal and under the direction of the Committee on Publications. The Board may appoint any other committees and delegate to them such power as may, in its judgment, seem desirable.

4. The Board shall fix the price of the official journal and of any other publications of the Association to non-members, but in no case shall the journal be sold for less than the annual dues of individual members.

ARTICLE VII—DUES.

1. Individual members of the Association shall each pay an initiation fee of Two Dollars (\$2) at the time of election.

2. The annual dues of each individual member shall be Four Dollars (\$4), including a subscription to the official journal.

3. The annual dues of each institutional member shall be Seven Dollars (\$7), including two (2) subscriptions to the official journal.

4. All dues shall be payable on the first of January of each year. Should the annual dues of any member remain unpaid beyond a reasonable time, his name shall be dropped from the list, after due notice.

5. New members entering the Association after April 1 of any year shall have their dues pro rated for the balance of the year, except when they desire to receive the full current volume of the official journal.

ARTICLE VIII—AMENDMENTS TO THE ARTICLES OF ASSOCIATION AND BY-LAWS.

1. The Articles of Association may be changed to provide for a Board of Nineteen (19) Trustees by vote of a majority of the Three (3) Trustees named in the original Articles. Subsequent changes, amendments or modifications, of the Articles of Association and any amendments to the By-Laws may be made at any annual meeting of the Association, or at any adjourned session thereof, or at any special meeting of the Association called for such purpose, by a two-thirds (2/3) vote of those present and entitled to vote; *provided* that such amendment shall have been printed in the official journal at least one (1) month before the date of such meeting.

2. No change in the Articles of Association shall have legal effect until a Certificate thereof, verified by oath of the President and under Seal of the Association, attested by the Secretary-Treasurer, shall be filed in the office of the Secretary of State of the State of Illinois and recorded in the office of the Recorder of Deeds for Cook County, Illinois.

ARTICLE IX—INTERPRETATION.

1. "Board," wherever used in these By-Laws, shall be taken to mean a Board of Trustees consisting of the Officers, the Committee on Publications and the Trustees elected as such, as provided in Article III.

2. It being the intent that this Association continue as successor to the unincorporated The Mathematical Association of America, these By-Laws shall be construed liberally to that effect.

THE UNDERSIGNED, CHAIRMAN OF THE ORGANIZATION MEETING OF THE BOARD OF TRUSTEES OF THE MATHEMATICAL ASSOCIATION OF AMERICA (INCORPORATED), HEREBY CERTIFIES that the above is a full, true and correct copy of the code duly adopted at such meeting, held September 10, 1920, as the By-Laws of said Association.

WITNESS MY HAND AND THE CORPORATE SEAL, this 11th day of September, A. D. 1920.
[CORPORATE SEAL]

HERBERT E. SLAUGHT,
Chairman as aforesaid.

THE "DANGER AREA" CURVE.

By A. S. MERRILL, University of Montana.

A moving object (ship) is a target for a projectile (torpedo) which travels horizontally under its own power. Certain limiting conditions under which the projectile would be fired, or launched, are known. It is desired to determine the boundary curve of the area of probable positions of the firing agent relative to the target, at the time of firing.

Let the target, of length AB but of negligible width, be considered first as fixed in position. For certain known conditions of probable error, the projectile has a range R if fired from a point in the perpendicular bisector of AB . Construct a circle of diameter R through A and B (Fig. 1). Suppose AB to be small in comparison with R . The middle point of AB is then approximately at M , the end point of the diameter ML perpendicular to AB ,—sufficiently close to be